F. Marshall Space Flight Center (MSFC)

1. Aero-M Small Unmanned Aerial System (UAS)

The Aero-M UAS, designed, built and flown by a team of MSFC engineers, won first place at the Academy of Program/Project and Education Leadership (APPEL) 2012 UAS Inaugural Competition at KSC on September 11, 2013. The competition provided NASA engineers with the opportunity to learn and apply system engineering and project management techniques during a short term, cradle-to-grave project to develop a search-and-rescue UAS. The contest culminated in the flight demonstration of the vehicle during a mock search-and-rescue operation. In March 2012, the NASA Headquarters funded each team from KSC, JSC, and MSFC with $12,500 for hardware procurement only and required the UAS competition to be finished by the end of September 2013.

FIGURE 35: AERO-M SMALL UNMANNED AERIAL SYSTEM

The mission objective of Aero-M (9.75 inches of height and 36.75 inches of wing span) was to autonomously fly with an imaging payload to locate targets, provide the pictures of targets, and report the target locations and characteristics. Three flight missions were conducted from altitudes between 50 and 100 feet at the north end of the SLF. Mannequins dressed in orange, street clothes, and camouflage were targets.

The Aero-M is designed to fly to altitudes up to 150 feet, at up to 20 mph operational velocity, and for flight times up to 35 minutes. The vehicle is equipped with an on-board FTS and manual flight control capability that can override autonomous flight mode for contingency. To compete at KSC, the design and as-built configuration of Aero-M were certified for flight by completing a series of integrated tests at MSFC West Test Area. The Aero-M received Flight Safety Release in May 2013 through the Langley Research Center Airworthiness Safety Review Board which was supported by KSC and the NASA Range Safety Office.

2. Mighty Eagle

The Mighty Eagle was originally built in 2009 as Cold Gas Test Article to validate thruster configuration and flight velocity controlled algorithm. The Cold Gas Test Article was modified with additional capability and longer flight duration (up to 1 minute) during 2010 and 2012 under Lunar Lander Project, and became known as Warm Gas Test Article or Mighty Eagle since then.

The Mighty Eagle can fly autonomously with manual command/abort capability. It has a custom avionics controller using a flight-like RAD750 Processor; sensor suite of IMU, altimeter, and

optical camera; peroxide propulsion system using nitrogen as pressurant; throttle capable central thruster for gravity offset; 16 attitude control thrusters; and 3 descent thrusters.

During FY 2013, the Mighty Eagle has performed four flights at MSFC West Test Area demonstrating a hazard avoidance system designed by MSFC engineers based on a commercial off-the shelf (COTS) stereo camera. The stereo camera is a good option in developing a low-weight, low-power, and low-cost hazard avoidance system for small robotic missions because it can detect large boulders at close range given adequate lighting conditions.

FIGURE 36: MIGHTY EAGLE FLIGHT TEST

The duration of each Mighty Eagle flight test was about 38 seconds, and the mission profile was ascending up to an altitude of 30 meters and 45 meters translating distance at different speeds. Because the MSFC-designed hazard avoidance system is an open loop currently, the flight test objectives were limited to taking images and processing the imaging data to generate a disparity map of surveyed terrain. From the flight tests, the Mighty Eagle team identified the need for further improvement of the in-house developed algorithm for image processing as well as the maximum capability of the COTS stereo camera.

3. Space Launch System Program (SLSP)

During FY 2013, the SLSP has been diligently working with Eastern Range USAF 45 SW in tailoring the AFSPCMAN 91-710 Volume 4 (Flight Termination System Design Requirements) and Volume 8 (Tracking and Telemetry Design Requirements). The current plan is to complete tailoring of both Volumes by spring of 2014. The SLSP has also been supporting the tailoring of AFSPCMAN 91-710 Volume 1, 2, 3, 5, and 6 being led by the MPCV Program and GSDO Program under HERSP.

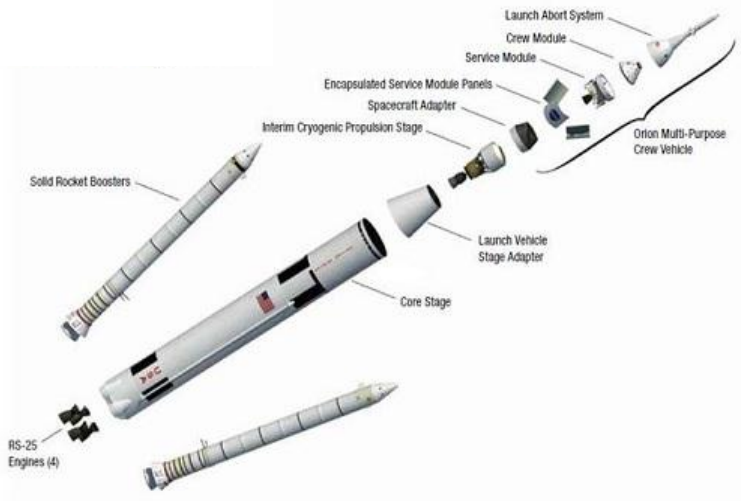

FIGURE 37: SLS 70-METRIC TON INITIAL CONFIGURATION

FIGURE 38: ARTIST'S CONCEPTION OF AN SLS LAUNCH

In November 2012, the SLSP participated in the Tri-Program (SLS, MPCV, and GSDO) Introduction (PI) to USAF 45th SW for Exploration Missions. The outcome of PI is 45 SW Statement of Capability affirming SLSP as a future range user and commitment of USAF 45 SW resources for the Exploration Missions (EM-1 and EM-2) launch plans.

In June 2013, SLSP released the baseline of FTS architecture and hardware list in the SLS-SPEC-140 SLSP FSS description as a product for the June 2013 Preliminary Design Review (PDR).

Since then, SLSP coordinated with HERSP, USAF 45 SW, and Exploration System Development (ESD) in providing the SLS Program memorandum supporting the Human Exploration Operations Mission Directorate waiver request to the National Security Agency (NSA) on EFTS requirement.